

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claim 1 (Original): An ion source for use with an ion implant device, the ion source comprising:

an ionization chamber defined by a plurality of side walls defining an ionization volume, one of said sidewalls including an ion extraction aperture for enabling an ion beam to be extracted from said ionization chamber along a predetermined axis defining an ion beam axis;

an electron beam source and an aligned beam receptor configured relative to said ionization chamber to cause an electron beam to be directed across the ionization volume of said ionization chamber in a direction generally perpendicular to said ion beam axis for ionizing gas in the ionization chamber by direct electron impact ionization by energetic electrons; and

a gas source in fluid communication with said ionization chamber.

Claim 2 (Cancelled)

Claim 3 (Cancelled)

Claim 4 (Cancelled)

Claim 5 (Cancelled)

Claim 6 (Cancelled)

Claim 7 (Cancelled)

Claim 8 (Cancelled)

Claim 9 (Cancelled)

Claim 10 (Cancelled)

Claim 11 (Cancelled)

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Claim 61 (Cancelled)

Claim 62 (Cancelled)

Claim 63 (Cancelled)

Claim 64 (Cancelled)

Claim 65 (Cancelled)

Claim 66 (Newly Added): A multi mode ion source comprising:

an ion source incorporating an ionization chamber for ionizing gas species and configured to have at least two discrete modes of operation; namely, a reflex mode and a non-reflex mode of operation.

Claim 67 (Newly Added): The ion source as recited in claim 66, further including a cooling mechanism, wherein said ionization chamber is actively cooled by said cooling mechanism.

Claim 68 (Newly Added): The ion source as recited in claim 67, further including a second member, wherein said cooling mechanism comprises said ionization chamber being disposed in conductive heat transfer relationship with a second member, the temperature of said second member being actively controlled defining a temperature controlled body.

Claim 69 (Newly Added): The ion source as recited in claim 68, further including a gas interface, wherein said conductive heat transfer relationship includes a gas interface between one or more walls of said ionization chamber and said temperature controlled body.

Claim 70 (Newly Added): The ion source as recited in claim 68, wherein said temperature controlled body is water-cooled.

Claim 71 (Newly Added): The ion source as recited in claim 69, wherein said temperature controlled body is water cooled.

Claim 72 (Newly Added): The ion source as recited in claim 68, wherein said temperature controlled body is heated by a heater element.

Claim 73 (Newly Added): The ion source as recited in claim 68, wherein the temperature control is accomplished by a control system.

Claim 74 (Newly Added): The ion source as recited in claim 66, wherein said non-arc discharge mode is defined by electron impact ionization resulting in a low plasma density within said ionization chamber of said ion source.

Claim 75 (Newly Added): The ion source as recited in claim 66, wherein said arc discharge mode is defined by the formation of a plasma by said arc discharge within said

ionization chamber of said ion source, the plasma density thus formed being substantially higher than that obtained in said non-arc discharge mode.

Claim 76 (Newly Added): The ion source as recited in claim 74, wherein said ion source includes a system for injection of a directed beam of electrons defining an electron beam into said ionization chamber of said ion source resulting in electron impact ionization in said non arc discharge mode.

Claim 77 (Newly Added): The ion source as recited in claim 75, wherein said ion source includes an electron source in direct contact with said plasma within said ionization chamber such that said plasma is sustained by said electron source in said arc discharge mode.

Claim 78 (Newly Added): The ion source as recited in claim 76, wherein said system includes an electron source for generating said electron beam.

Claim 79 (Newly Added): The ion source as recited in claim 78, wherein said electron source is a thermionic emitter of electrons.

Claim 80 (Newly Added): The ion source as recited in claim 79, wherein said thermionic emitter is a hot filament.

Claim 81 (Newly Added): The ion source as recited in claim 79, wherein said thermionic emitter is an indirectly heated cathode.

Claim 82 (Newly Added): The ion source as recited in claim 77, wherein said electron source includes a thermionic emitter of electrons.

Claim 83 (Newly Added): The ion source as recited in claim 81, wherein said electron source is external to the ionization chamber of said ion source.

Claim 84 (Newly Added): The ion source as recited in claim 82, wherein said electron source is external to the ionization chamber of said ion source.

Claim 85 (Newly Added): The ion source as recited in claim 83 further including a cooled support structure and, wherein said electron source is mounted to a cooled support structure.

Claim 86 (Newly Added): The ion source as recited in claim 84, further including a cooled support structure and wherein said electron source is mounted to said cooled support structure.

Claim 87 (Newly Added): The ion source as recited in claim 85, wherein said cooled support structure is configured to be cooled by deionized water.

Claim 88 (Newly Added): The ion source as recited in claim 86, wherein said cooled support structure is cooled by deionized water.

Claim 89 (Newly Added): The ion source as recited in claim 85, wherein said cooled support structure is configured to be cooled through a gas interface between said support structure and an adjacent temperature-controlled body.

Claim 90 (Newly Added): The ion source as recited in claim 86, wherein said cooled support structure is cooled through a gas interface between said support structure and an adjacent temperature-controlled body.

Claim 91 (Newly Added): The ion source as recited in claim 66, further including an electrode, the polarity of the said electrode being positive with respect to said ionization chamber during operation in non-arc discharge mode, and negative with respect to said ionization chamber in arc discharge mode.

Claim 92 (Newly Added): The ion source as recited in claim 91, wherein in said arc discharge mode, said electrode functions as an electron repeller.

Claim 93 (Newly Added): The ion source as recited in claim 66, wherein the ionization chamber of said ion source contains an axial magnetic field.

Claim 94 (Newly Added): The ion source as recited in claim 93, wherein said axial field provides confinement of the electron beam in non-arc discharge mode, and enables operation in a reflex geometry in arc discharge mode.

Claim 95 (Newly Added): The ion source as recited in claim 82, wherein said thermionic emitter is a hot filament.

Claim 96 (Newly Added): The ion source as recited in claim 82, wherein said thermionic emitter is an indirectly heated cathode.

Claim 97 (Newly Added): A vaporizer for use with an ion source, the vaporizer comprising:

a crucible;

a thermally conductive gas interface between said crucible and said vaporizer housing.

Claim 98 (Newly Added): The vaporizer as recited in claim 102, further including a temperature control system for controlling the temperature of said vaporizer housing.

Claim 99 (Newly Added): The vaporizer as recited in claim 103, wherein said temperature control system includes resistive heater and a cooler in thermal contact with said vaporizer body.

Claim 100 (Newly Added): The vaporizer as recited in claim 104, wherein said cooler is a heat exchanger.

Claim 101 (Newly Added): The vaporizer as recited in claim 105, further including a gas interface between said heat exchanger and said vaporizer body.